Michigan Wellhead Protection Program

What is Wellhead Protection?

- Nationwide effort to protect groundwater used by public water supply systems
- Resulted from amendments to Section 1428 of the Federal Safe Drinking Water Act in 1986
- Required the states develop and implement a wellhead protection program (WHPP)
- Required WHPPs address "**seven elements**"
- Michigan's WHPP approved by EPA in 1991.

What it is not!

Seven Elements of WHPP

1) Roles and Responsibilities: identify WHPP team
2) Wellhead Protection Area (WHPA): delineate the area that contributes groundwater to wells
3) Sources of Contamination: inventory sources of contamination within the WHPA.
4) Management: develop methods/plan to manage the WHPA and minimize threat to water supply (e.g. land-use restrictions, BMPs)
5) Contingency Planning: personnel, equipment and procedures to respond to water supply emergencies
6) New Wells: incorporate new sources into WHPP
7) Public Outreach and Education: involve the community – administrators, customers, etc.

WELLHEAD PROTECTION
A HISTORICAL PERSPECTIVE

JAMESTOWN VIRGINIA'S SOURCE WATER PROTECTION PROGRAM

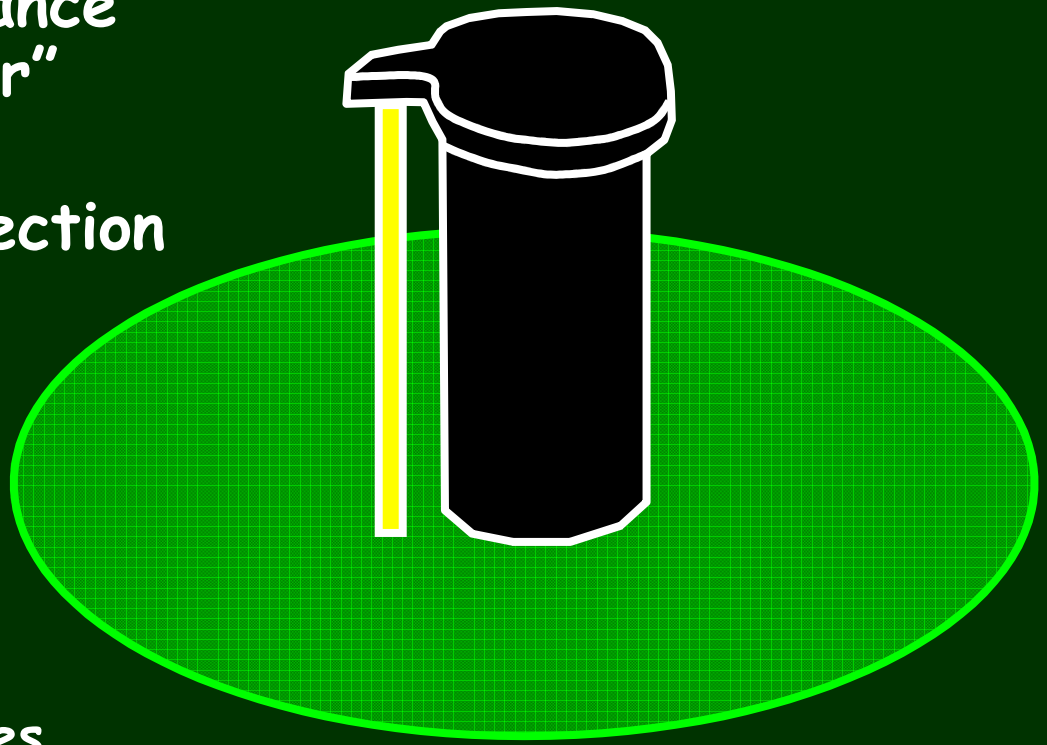
THE PROCLAMATION - 1610

"There shall be no man or woman dare to wash any unclean linen, wash clothes...nor rinse or make clean any kettle, pot or pan, or any suchlike vessel within twenty feet of the old well or new pump. Nor shall anyone aforesaid within less than a quarter mile of the fort, dare to do the necessities of nature, since by these unmanly, slothful, and loathsome immodesties, the whole fort may be choked and poisoned."

Governor Gage

Traditional Approach to Protecting GW Supplies

- Maintain Isolation Distance from "minor" and "major" sources
- Minor or Sanitary Protection Radius
  - Community – 200 feet
  - Noncommunity - 75 feet
- Major - existing and potential contaminant sources
  - LUST, landfills, 201 Sites, bulk chemical storage
  - Community – 2000 feet
  - Noncommunity - 800 feet

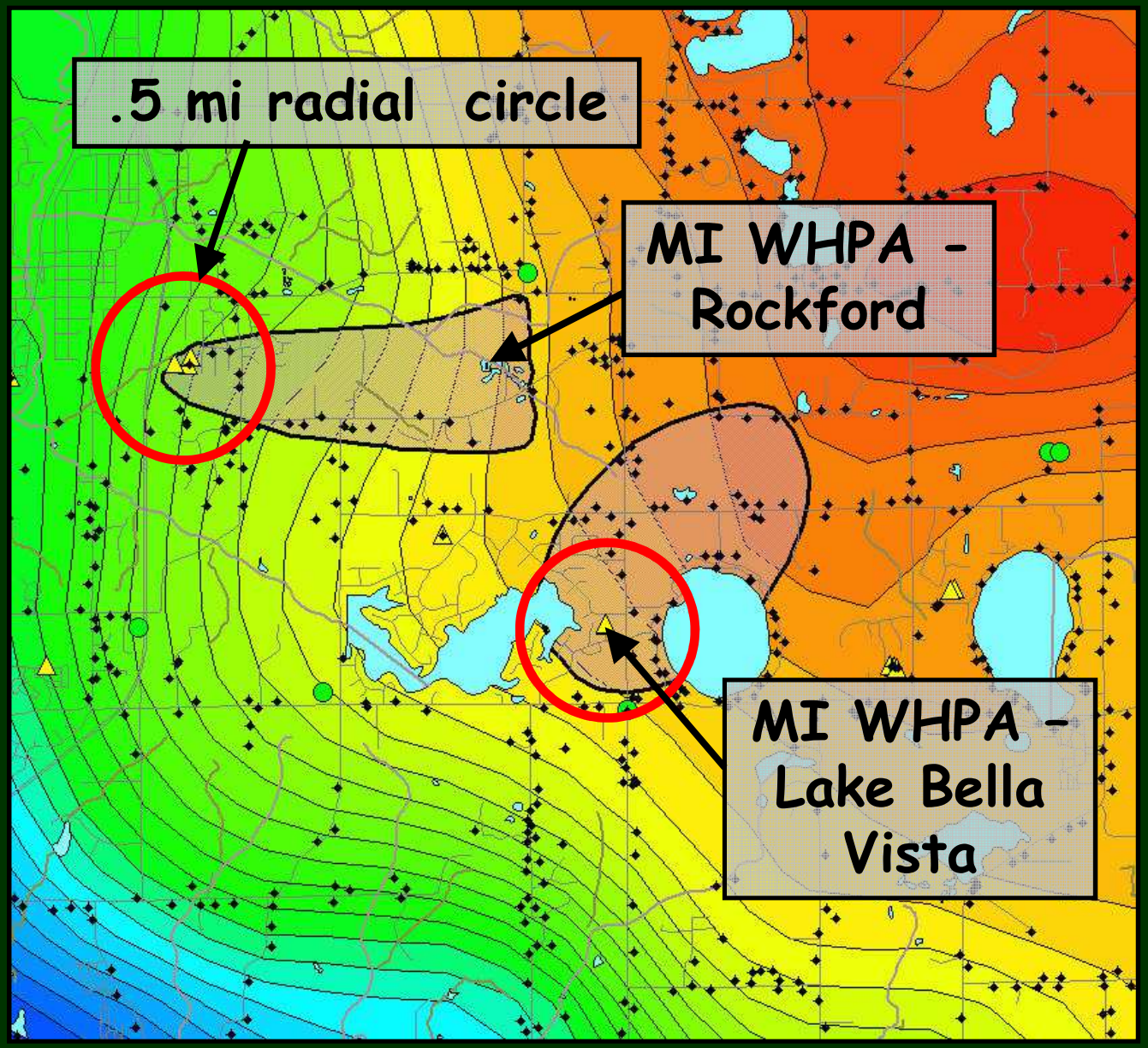


Wellhead Protection Area (WHPA)

The surface and subsurface area surrounding a water well or well field, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or wellfield

WHPA = 10 year time-of-travel

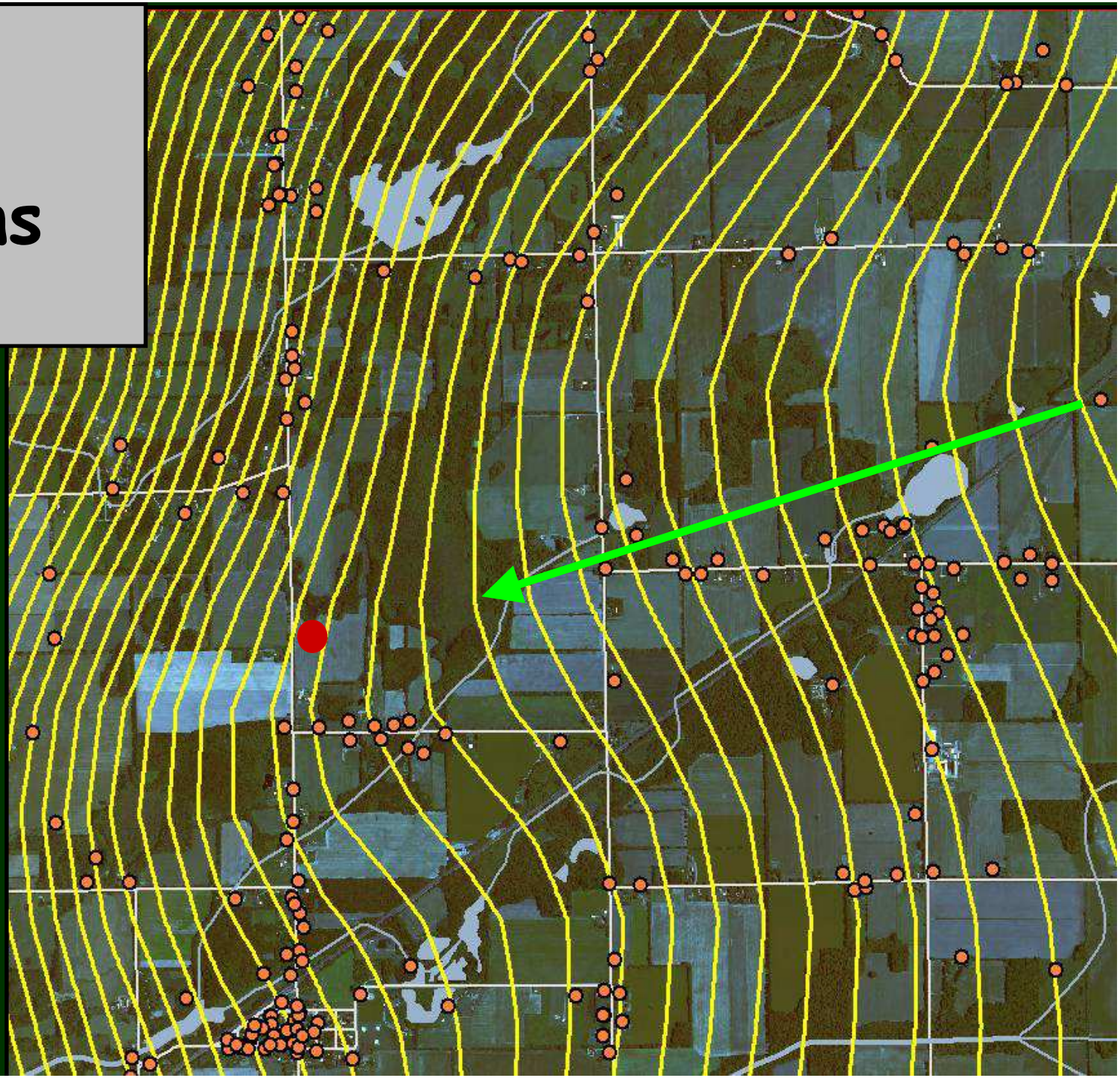
GW Flow-Based Delineation vs Fixed Radius



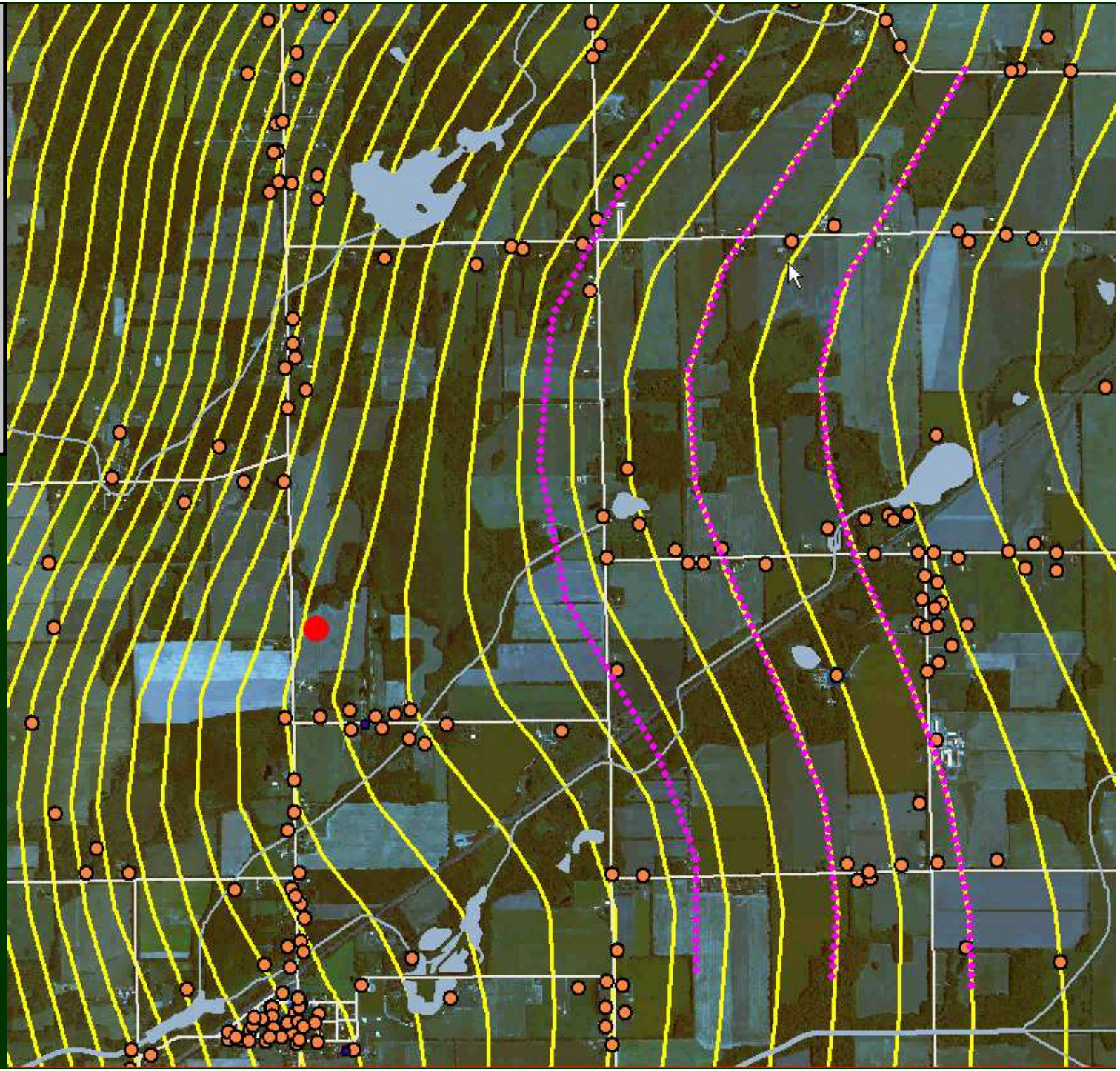
What information is need to delineate WHPA?

- Well Location
- GW Elevations
- Hydraulic Conductivity
- Pumping Rate

Map GW Elevations



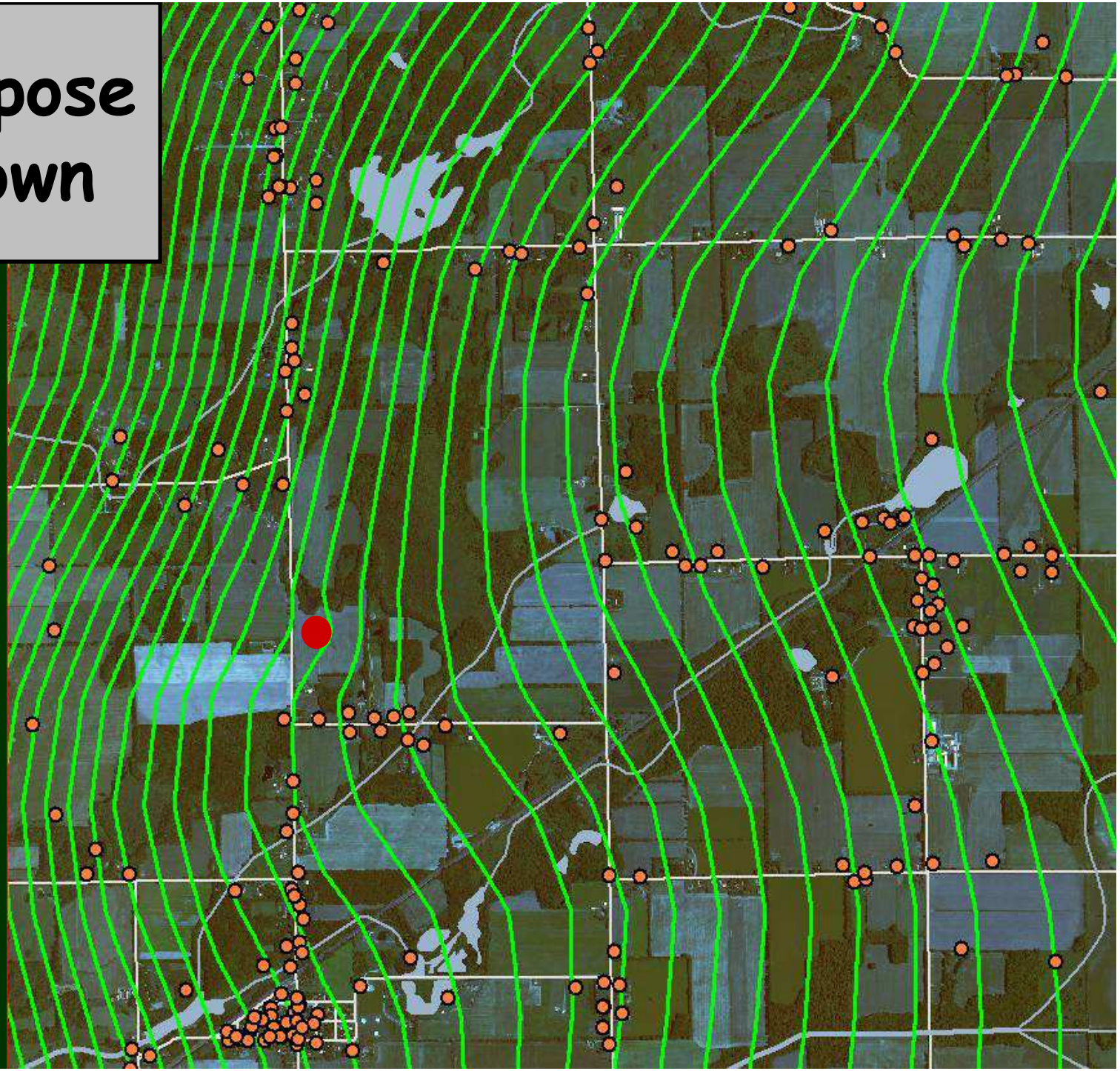
GW Flow No Pumping



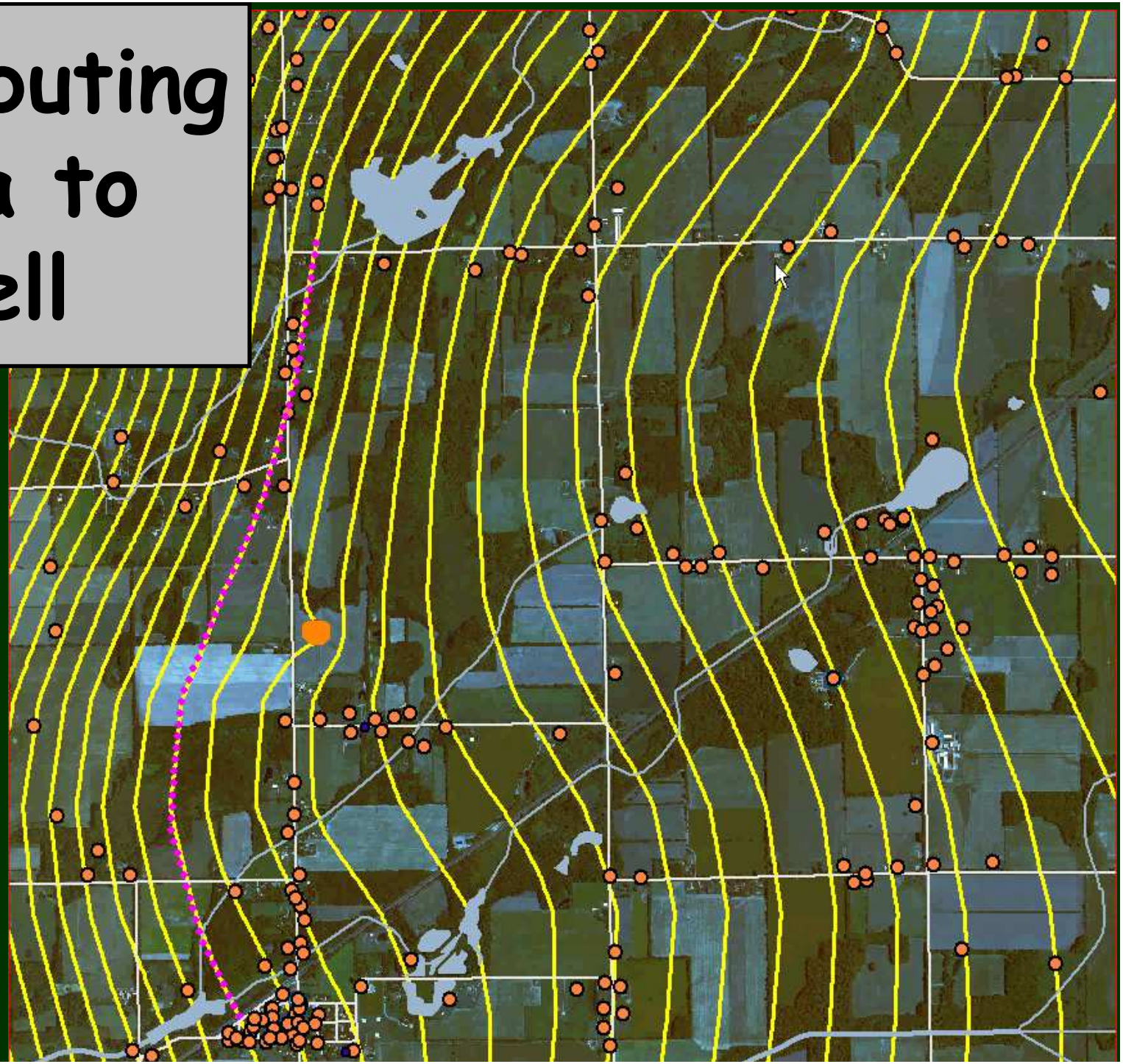
Calculate Drawdown

100 Days continuous pumping

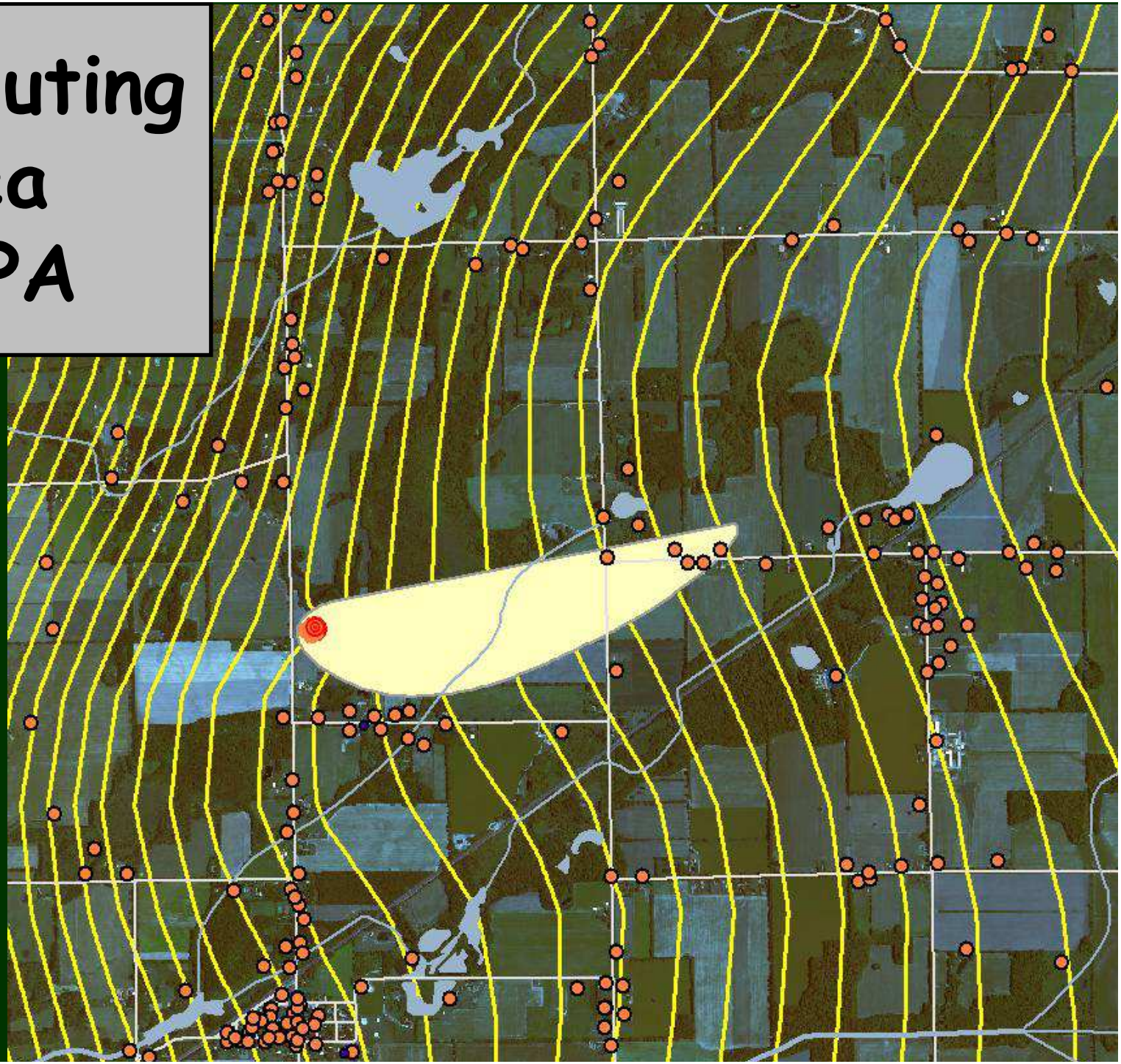
Superimpose Drawdown



Contributing Area to Well

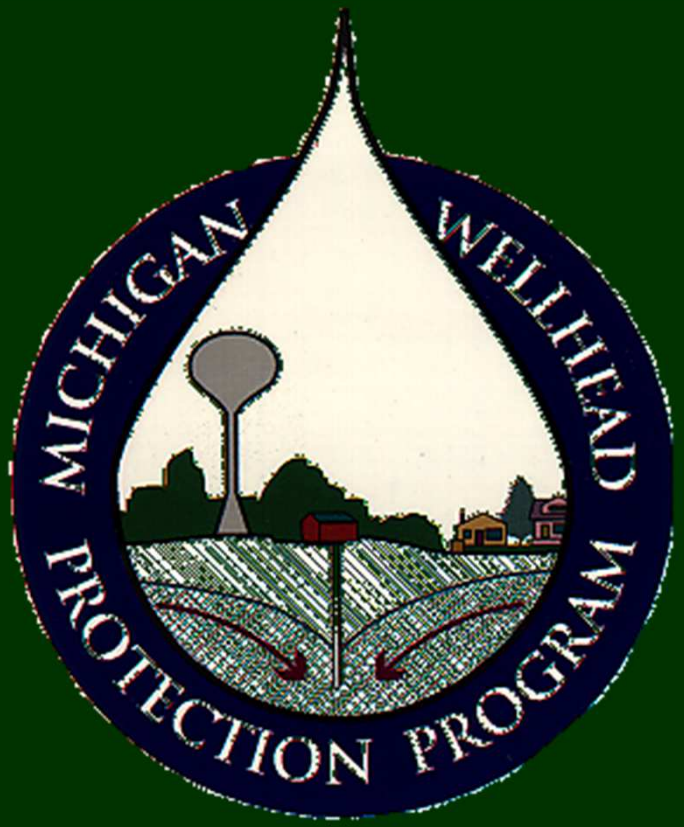


Contributing Area WHPA



MGMT

Michigan
Groundwater
Management
Tool



MGMT

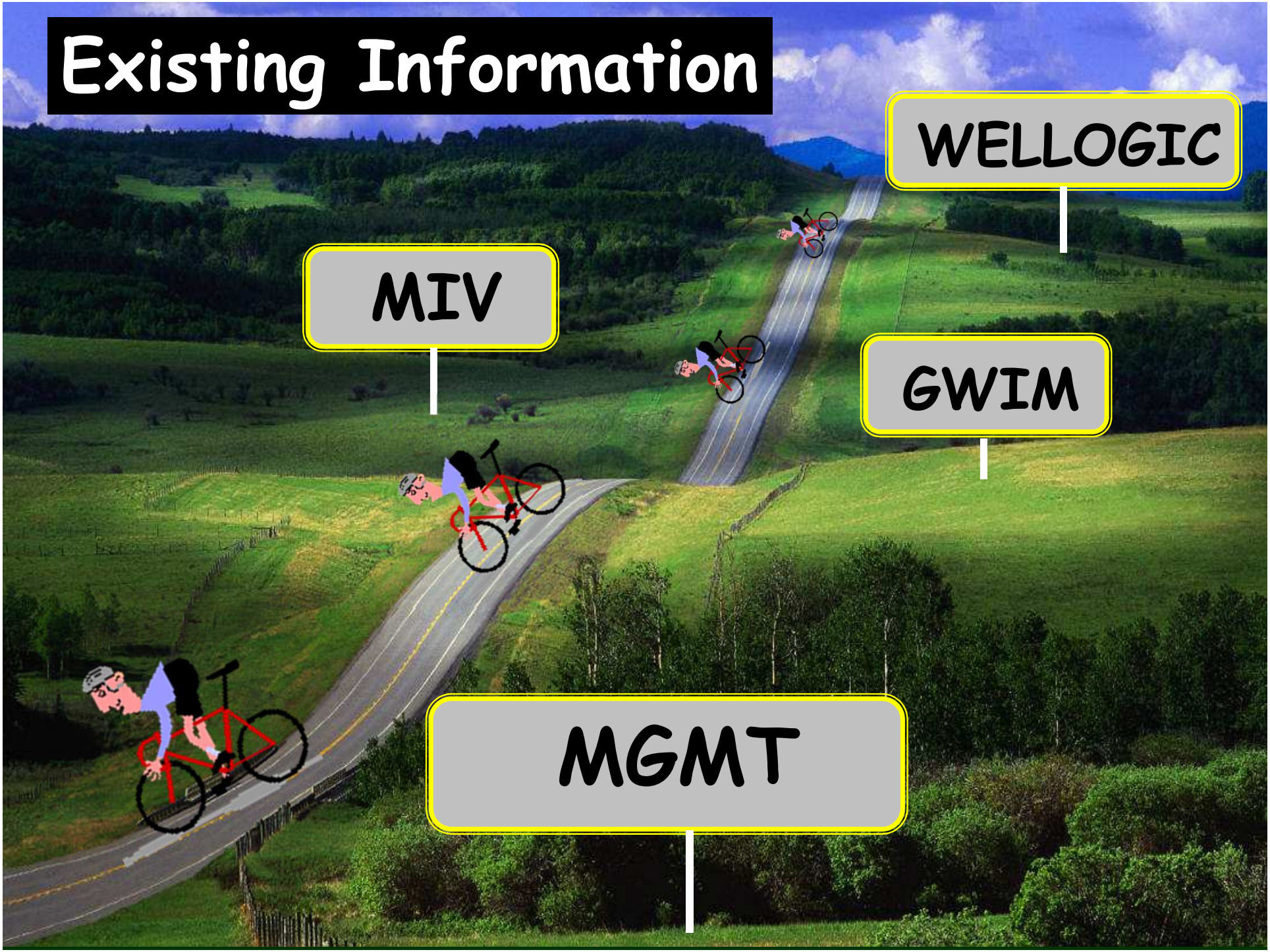
A tool for analyzing groundwater flow using available data

- Delineating WHPAs
- Contaminant migration
- Groundwater flow direction

MICHIGAN STATE UNIVERSITY COLLEGE OF ENGINEERING

DEQ

Why Not Use Existing Information?


Existing Information
WELLOGIC
MIV
GWIM
MGMT

NECESSARY INFORMATION

- GW Elevation Map
- Hydraulic Conductivity
- Well Location
- Pumping Rate

Available Data

WELLOGIC

- Water Well Database
- ~541,000 Records
- Well Locations
  - Lat/Long
- GW Elevations
  - Land Surface
  - Static Water Level
- K Estimates
  - From the GWIM Project
  - Lithology and Land System based

Information from Water Well and Pump Record

Location

Land Surface Elevation

Static Water Level

Static Water Elevation = 850 ft amsl

Geology K Assignment

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Wellogic

Import ID: 41501123023

Tax No:	Permit No:	County: Kent	Township: Solon

Well ID: 41000007355

Elevation: 870 ft.
Latitude: 43.237068018
Longitude: -85.5715985288
Method of Collection: Interpolation-Map

Town/Range: 10N 11W | Section: 23 | Well Status: Inactive | WSSN: 2059341 | Source ID/Well No: 001

Distance and Direction from Road Intersection: SUNSHINE FIELDS DAY CARE

Well Owner: TIDDLER, HAROLD

Well Address: 14651 WHITE CRK AVE, CEDAR SPRINGS, MI 49319

Owner Address: 14909 WHITE CRK AVE, CEDAR SPRINGS, MI 49319

Drilling Method: Cable Tool
Well Depth: 45.00 ft. Well Use: Type II public
Well Type: Replacement Date Completed: 9/12/1985
Casing Type: Steel - black Height:
Casing Joint: Threaded & coupled
Casing Fitting: Drive shoe
Diameter: 4.00 in. to 40.00 ft. depth
Borehole:

Pump Installed: Yes Pump Installation Only: No
Pump Installation Date: HP:
Manufacturer: Other Pump Type: Submersible
Model Number: Pump Capacity: 0 GPM
Drop Pipe Length: 30.00 ft. Pump Voltage:
Drop Pipe Diameter: Drilling Record ID:
Draw Down Seal Used: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 20.00 ft. Below Grade
Well Yield Test: Yield Test Method: Unknown
Pumping level 20.00 ft. after 1.00 hrs. at 40 GPM

Formation Description	Thickness	Depth to Bottom
Sand	10.00	10.00
Gravel & Clay	10.00	20.00
Red Clay	15.00	35.00
Sand Wet/Moist	10.00	45.00

Screen Installed: Yes Filter Packed: No
Screen Diameter: 3.75 in. Blank: 0.00 ft. Above
Screen Material Type:

Slot	Length	Set Between
10.00	5.00 ft.	40.00 ft. and 45.00 ft.

Fittings: Neoprene packer

Well Grouted: No

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	100 ft.	South

Abandoned Well Plugged: No
Reason Not Plugged:

Drilling Machine Operator Name:
Employment: Unknown
Contractor Type: Unknown Reg No: 0374
Business Name:
Business Address:

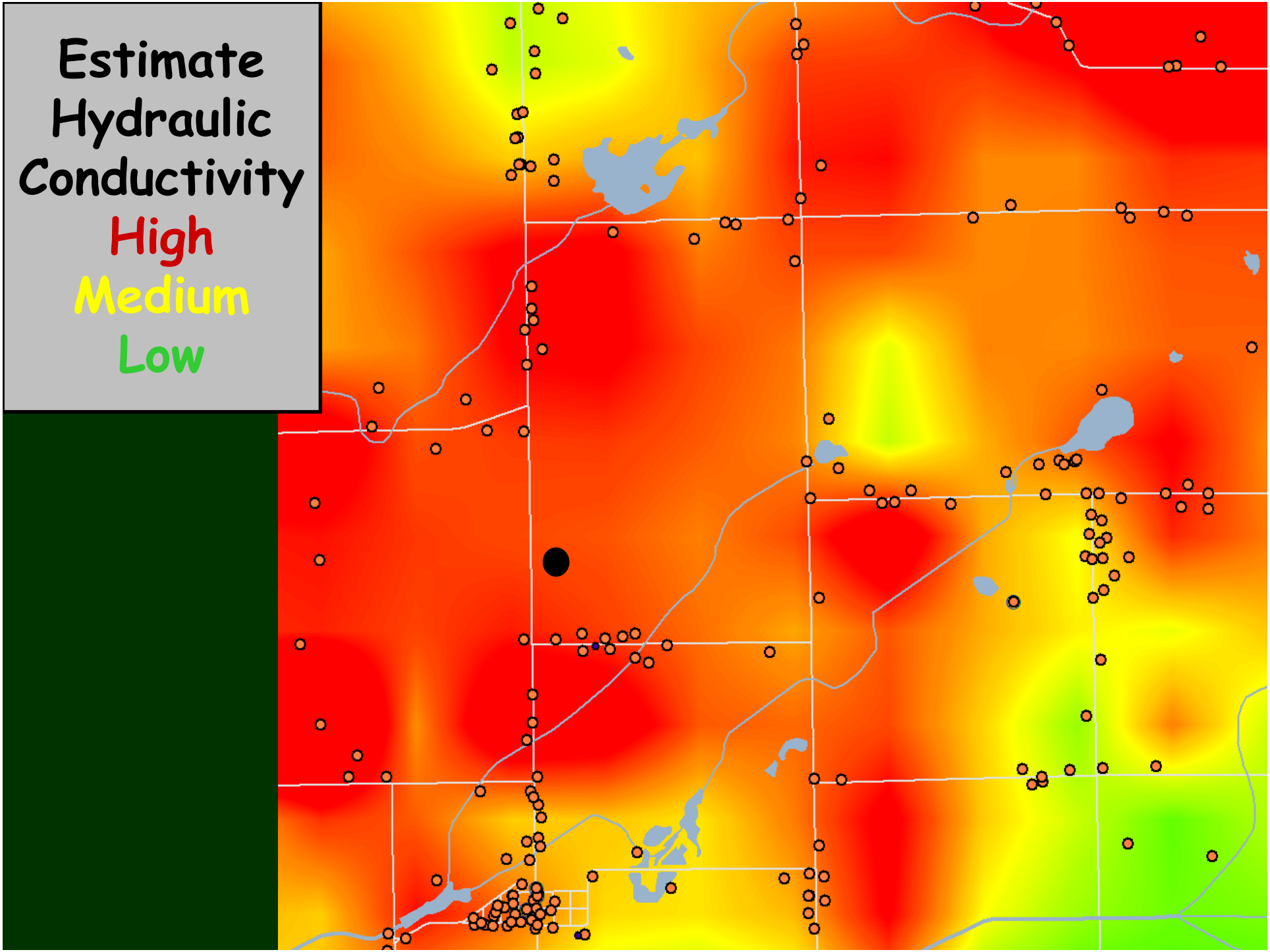
Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor Date

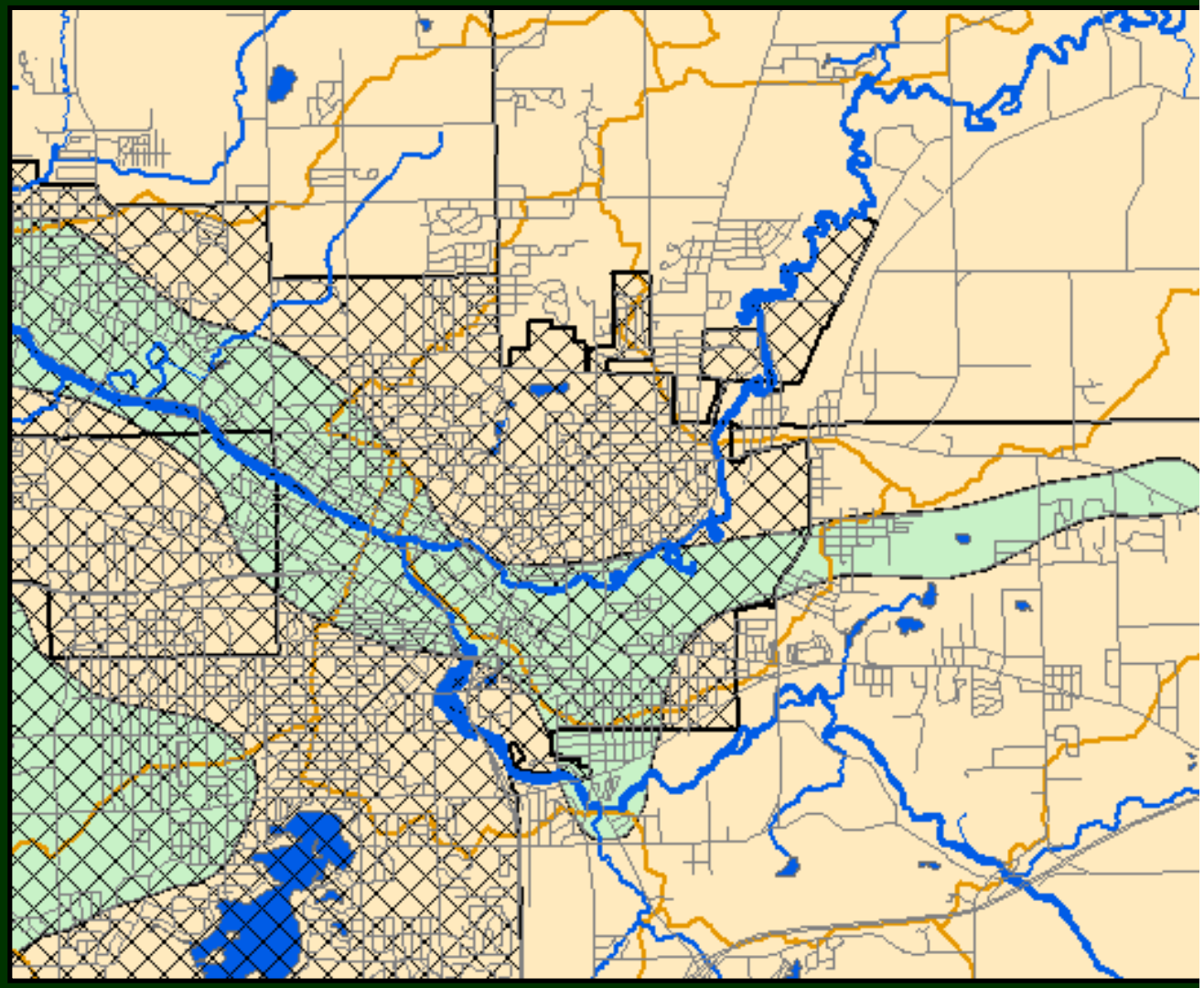
General Remarks:
Other Remarks: Pump Manufacturer: DECATUR PUMP CO

EQP-2017 (4/2010) Page 1 of 1 LHD 2/17/2000 5:24 PM

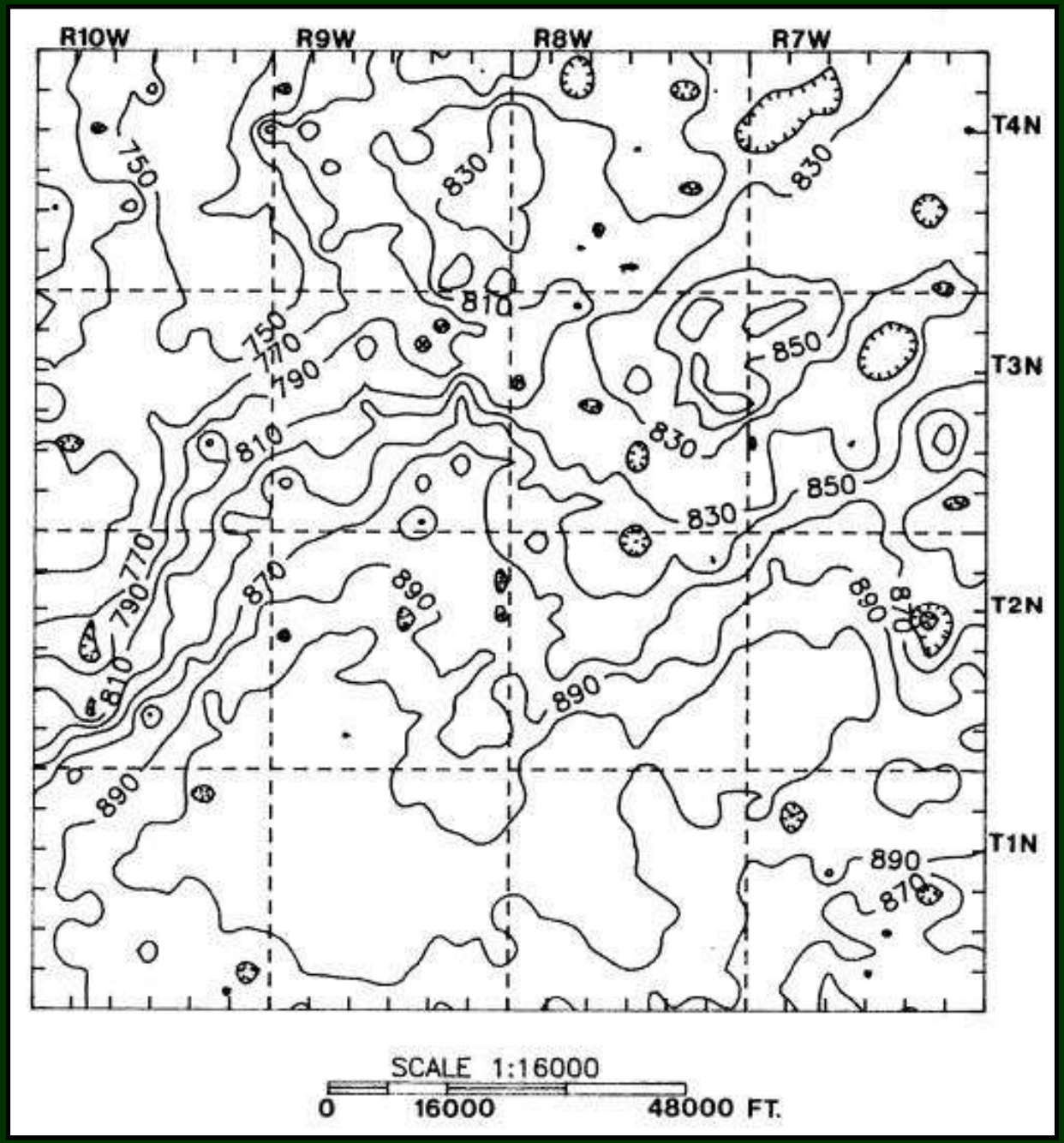

Estimate
Hydraulic
Conductivity
High
Medium
Low

Other Available Data

- Michigan Geographic Data Library
  - Political boundaries
  - Roads
  - Lakes
  - Rivers
  - Watershed boundaries
  - Air photos
  - Geologic maps
  - etc.



How Do We Map GW Elevations and Determine GW Flow Directions From Available Data?



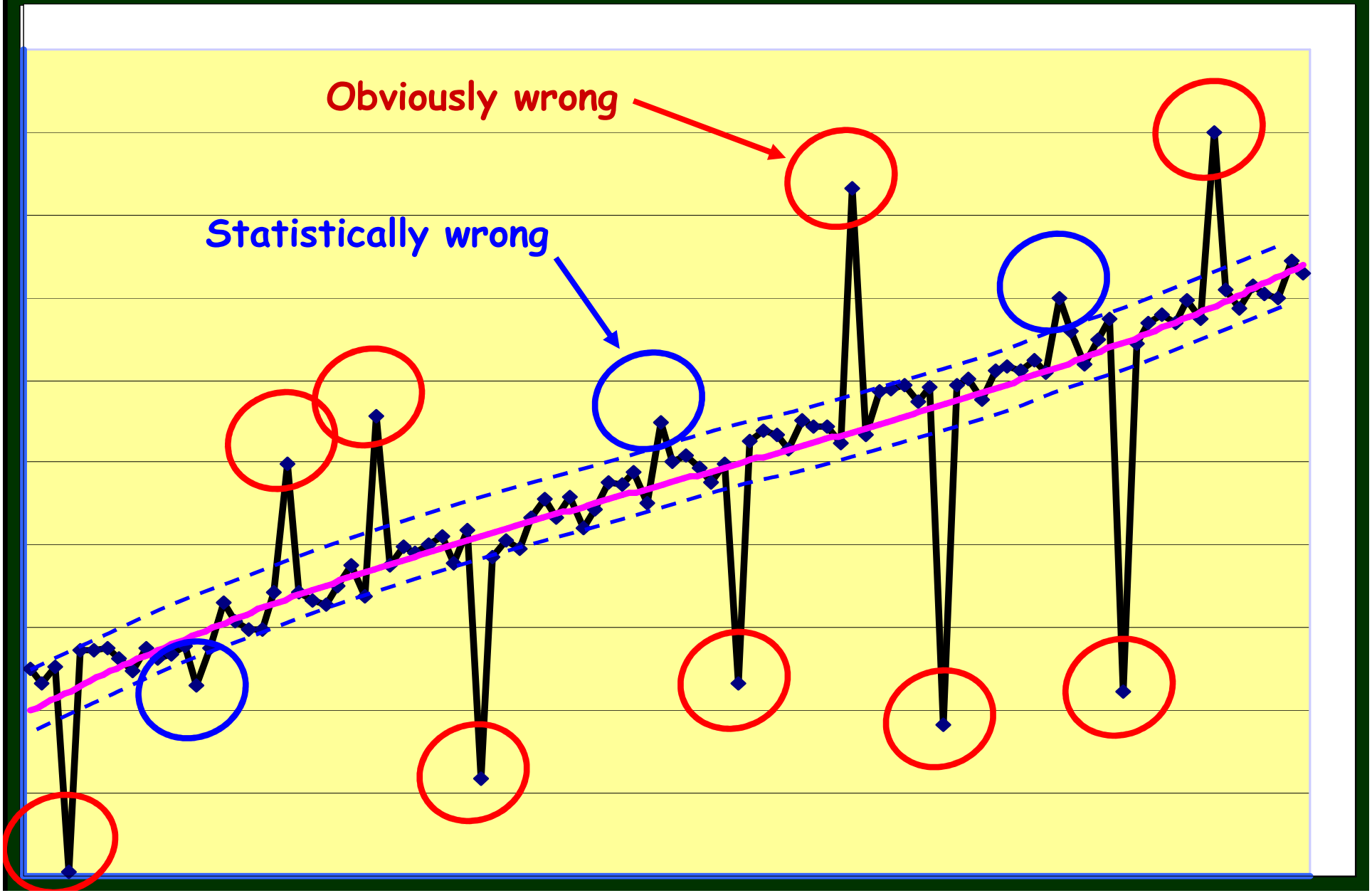
Potentiometric Surface from WELLOGIC Data

Basic Kriging

Data Processing

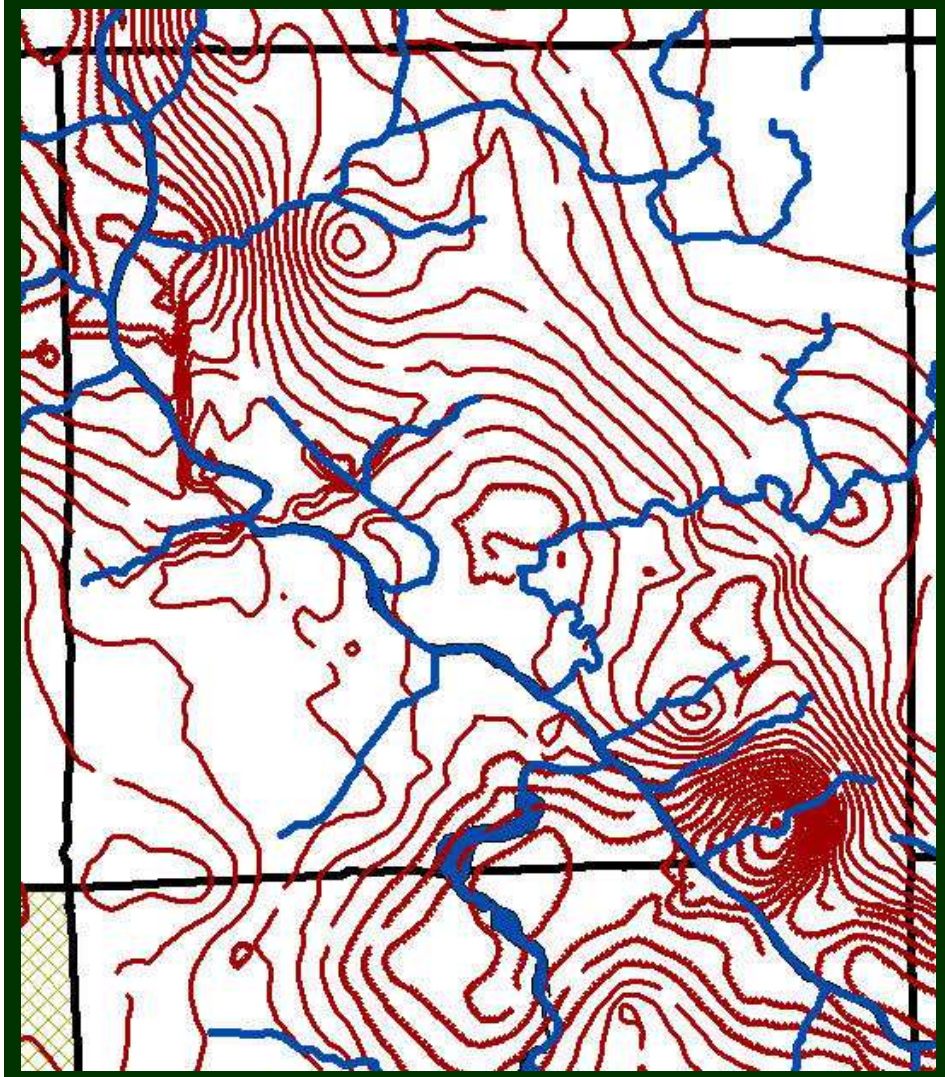
- Using water well records only
- Remove noise and data errors
  - Filtering
  - Outlier analysis
- Kriging
  - Data interpolation
  - Smooth surface depicting GW flow

Filtering and Outlier Analysis

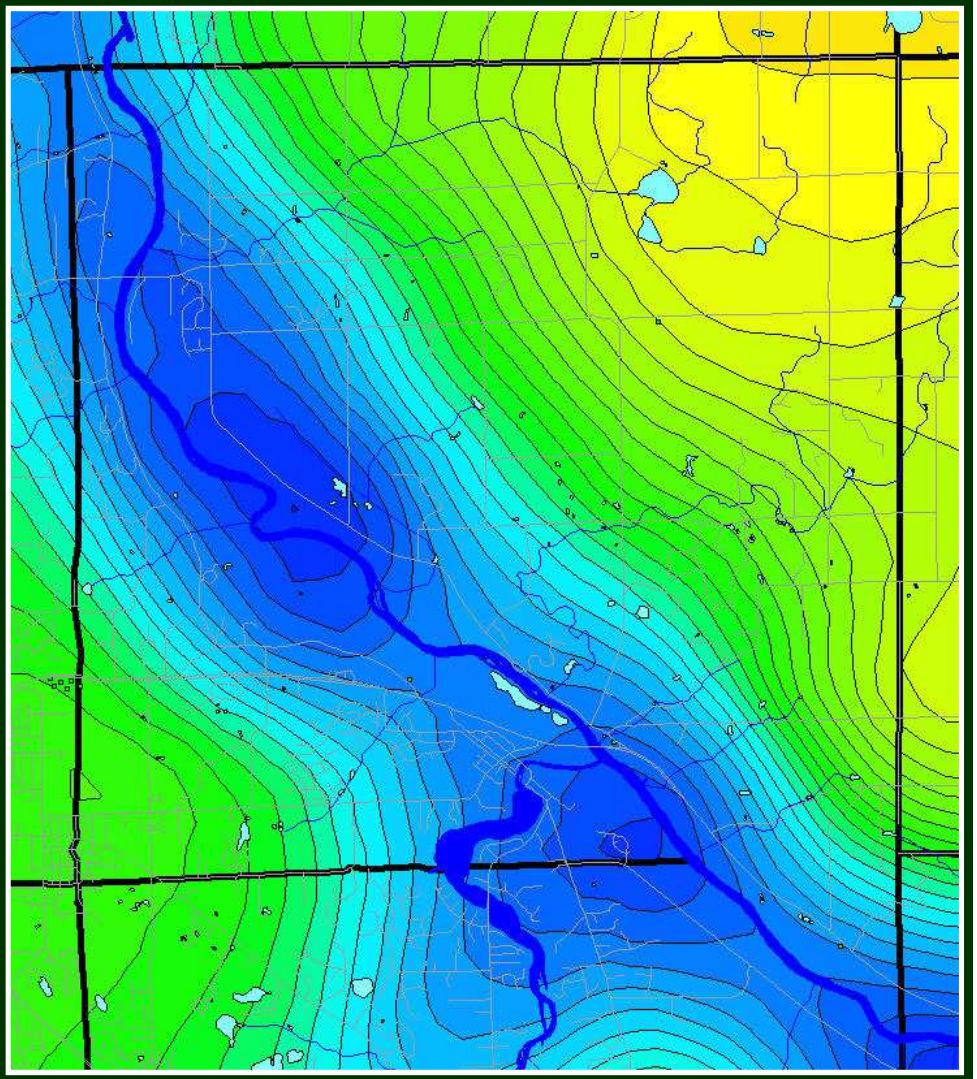


Potentiometric Surface Comparison

Standard Kriging



MGMT Kriging

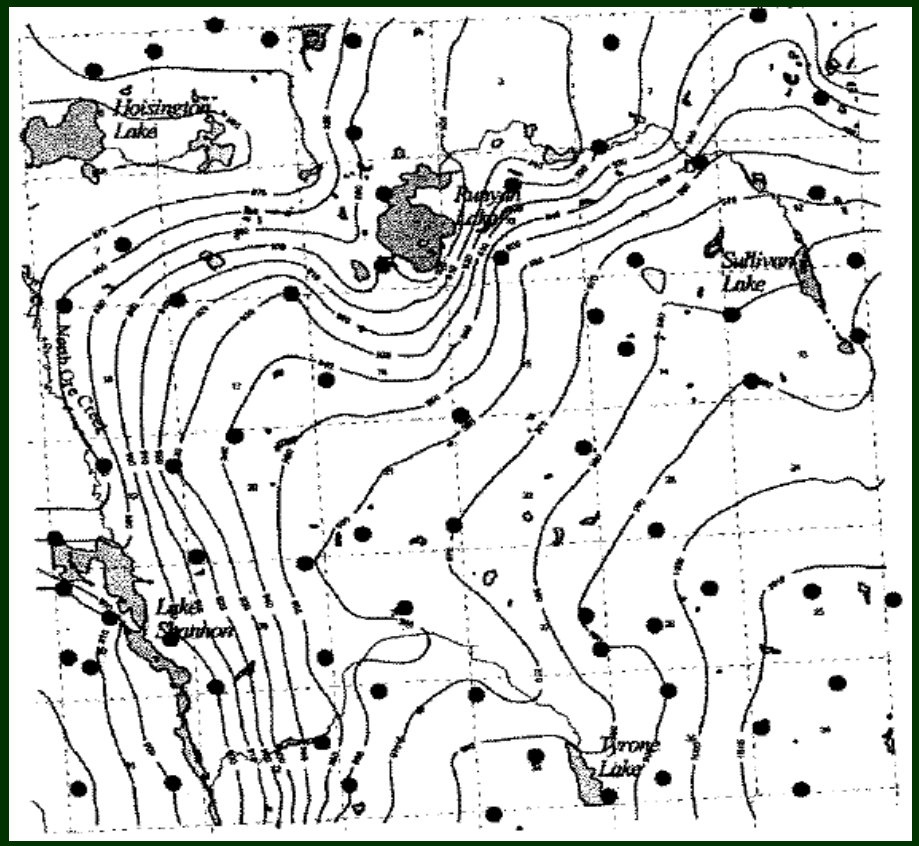


What Did We Do to Show That Our Data Processing Resulting in Correct GW Flow Directions?

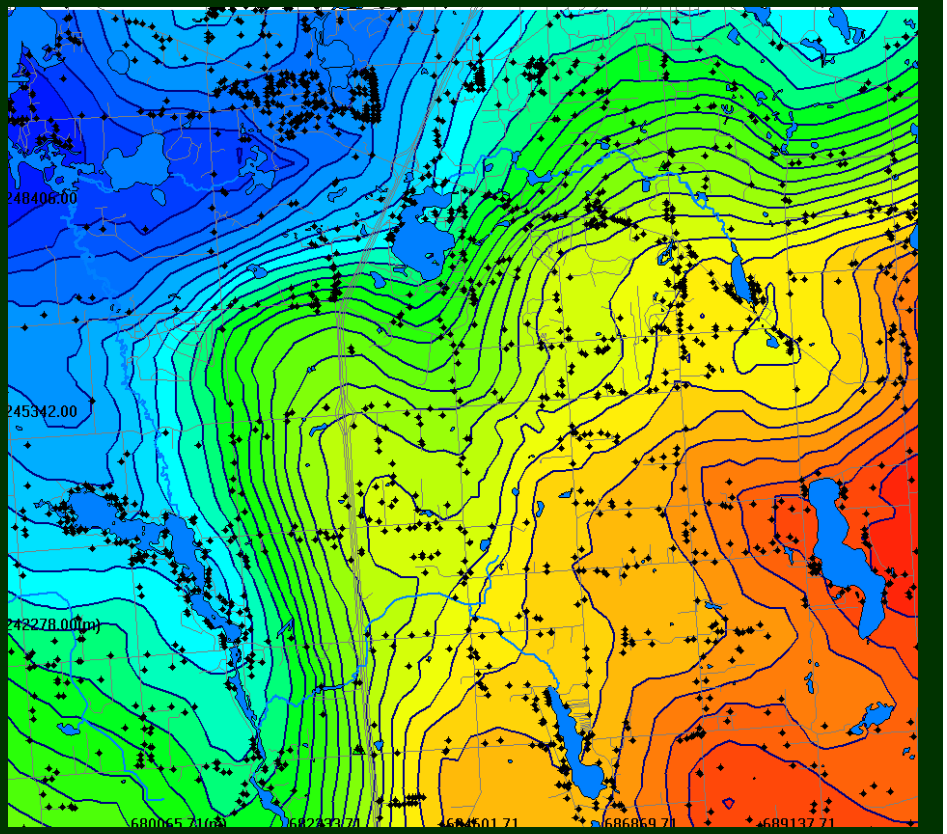
Comparison Between Field-Generated Maps And MGMT-Generated Maps

FIELD versus MGMT

Measured – 66 points

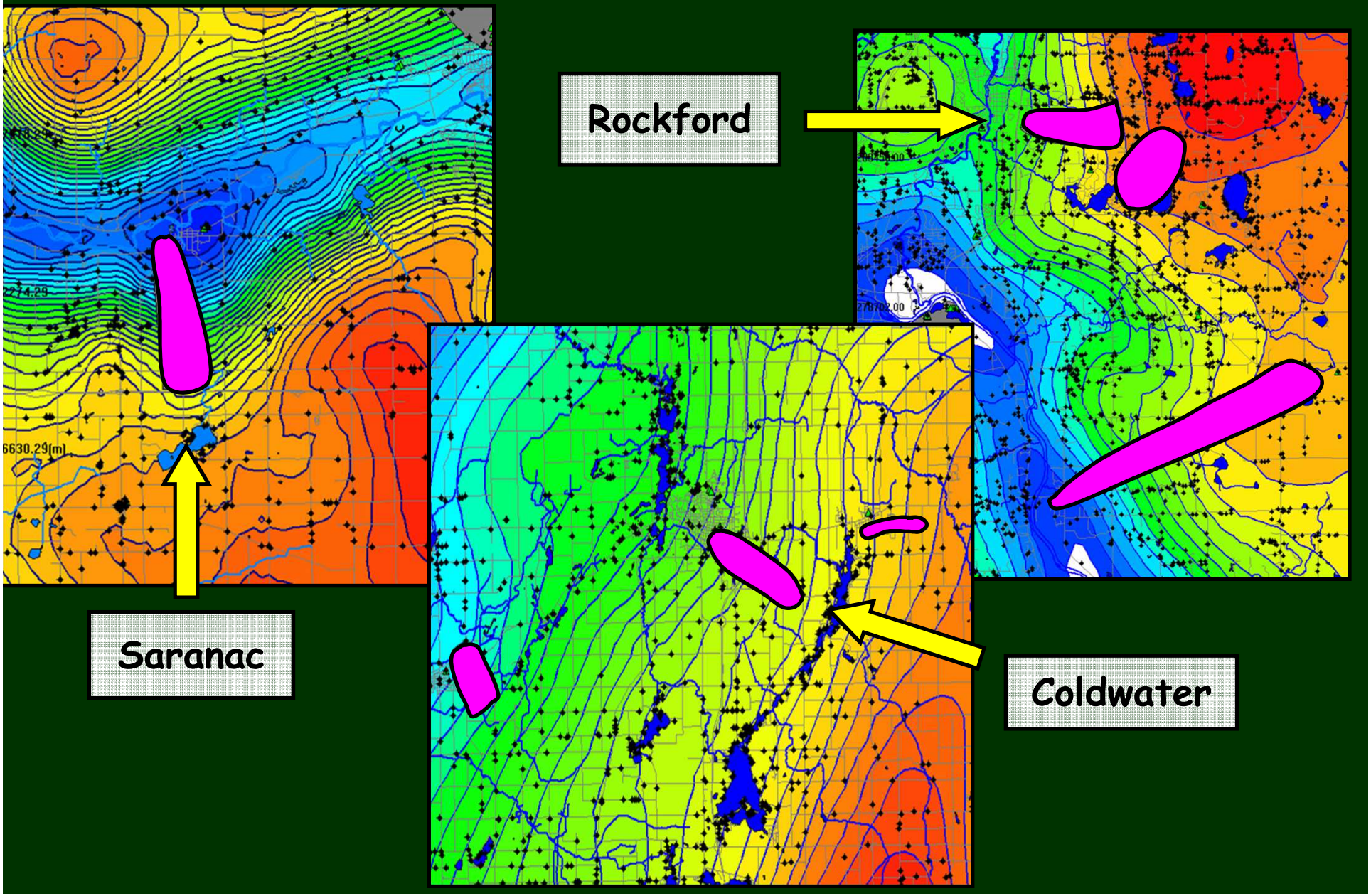


MGMT – 1737 points



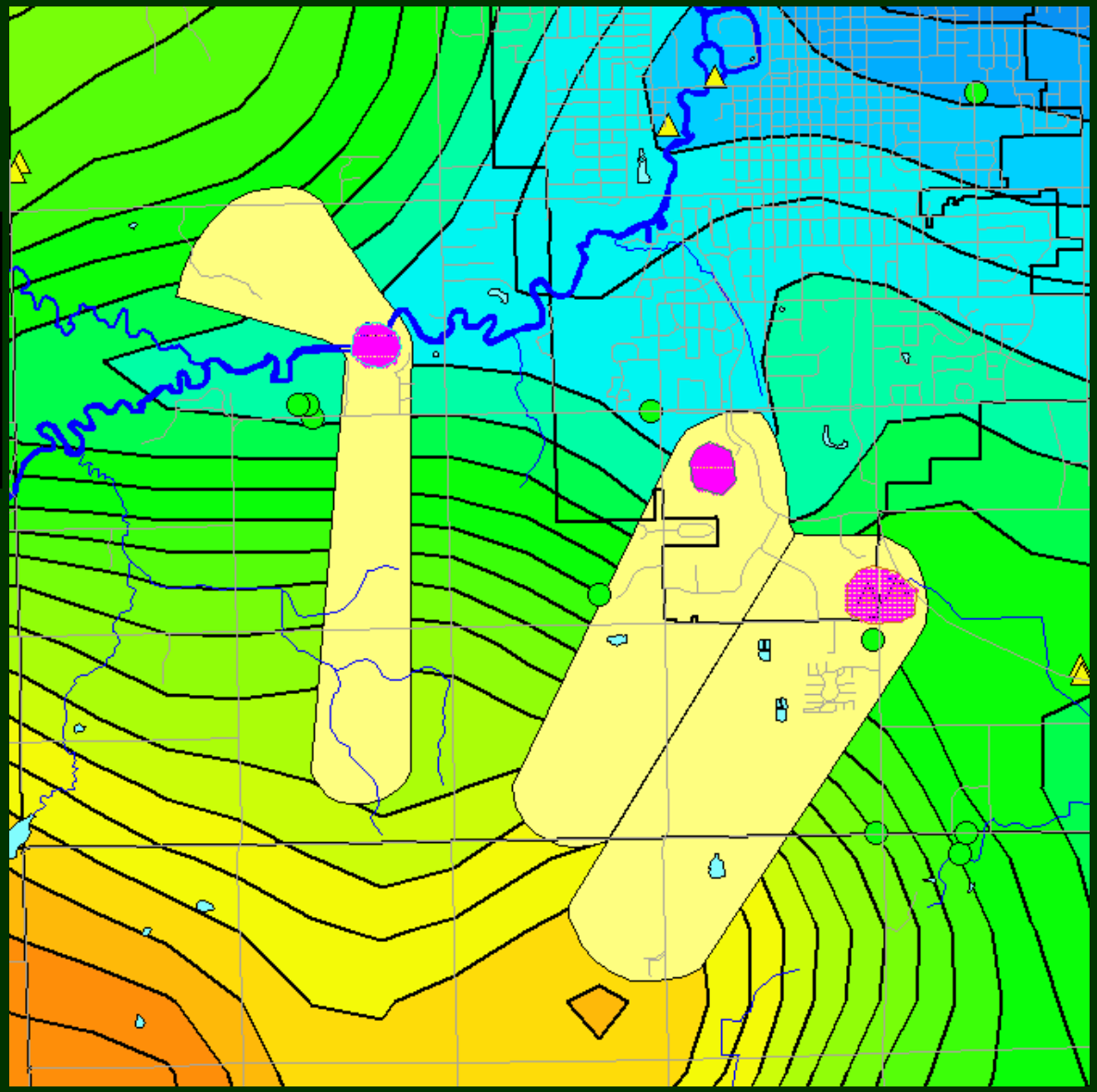
Comparison between Orientation of Traditional WHPAs and MGMT Maps

GW flow direction Verification



Compare traditional WHPA delineation with MGMT delineation

City of Mount Pleasant



Proposed Uses of MGMT

- Delineation of "Provisional" WHPAs:
  - Community water supplies without the resources to complete WHPA delineations
  - Nontransient, Noncommunity water supplies
  - Completed district by district
- Evaluation of new well sites
  - Community
  - Non-Community systems

Note on Provisional WHPAs

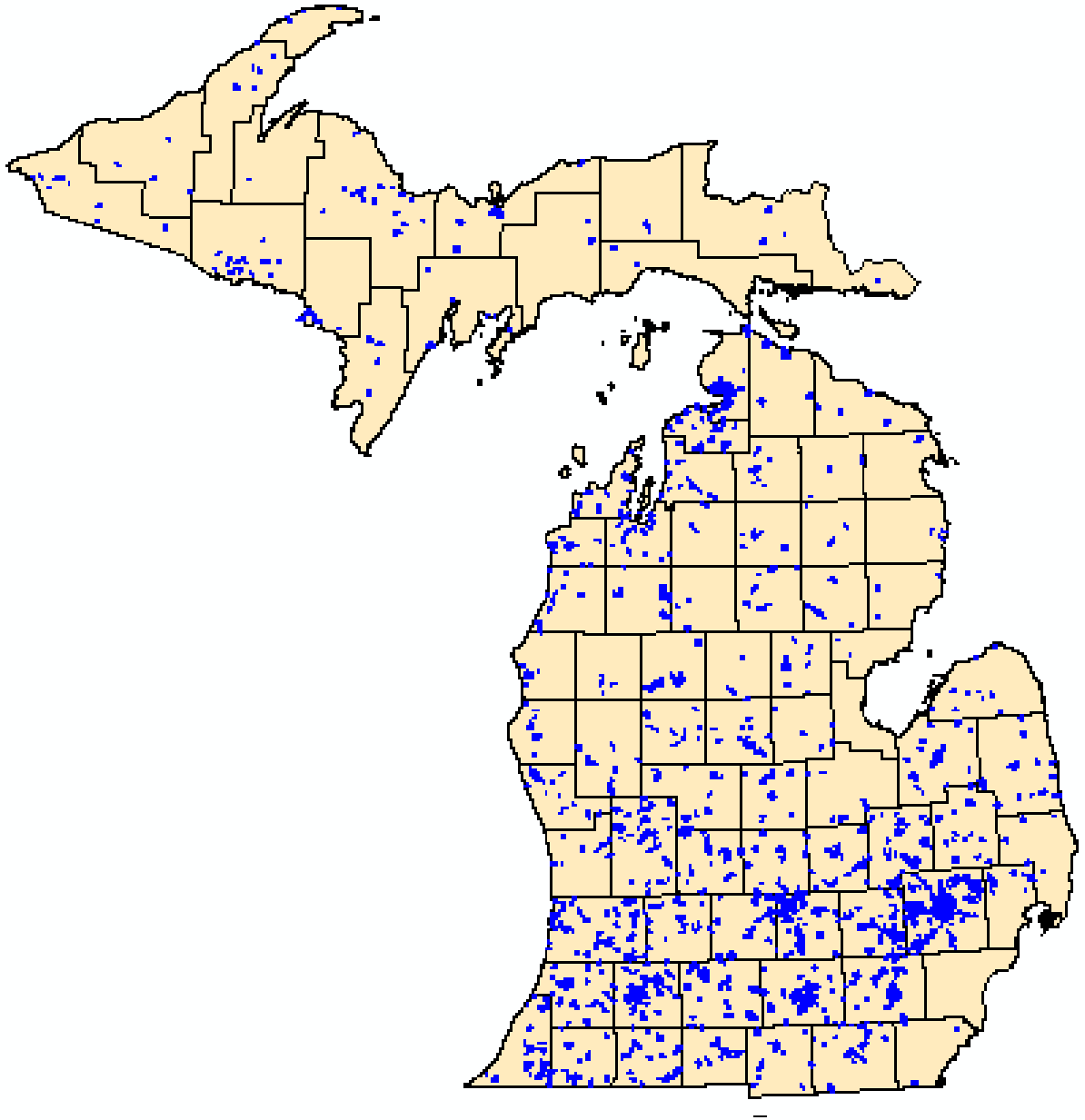
- Traditional WHPAs are differentiated from Provisional WHPAs
- Wellhead Protection activities in both are eligible for grant funds
- They do not eliminate the need or value of traditional WHPA delineations

Community Water Supply Database

- **3,427 Wells**
  - Confirmed Locations
  - Lat-Long
- **WHPAs**
  - Traditional – 329
  - Provisional – 890
  - Low Tritium – 53

Total - 1272

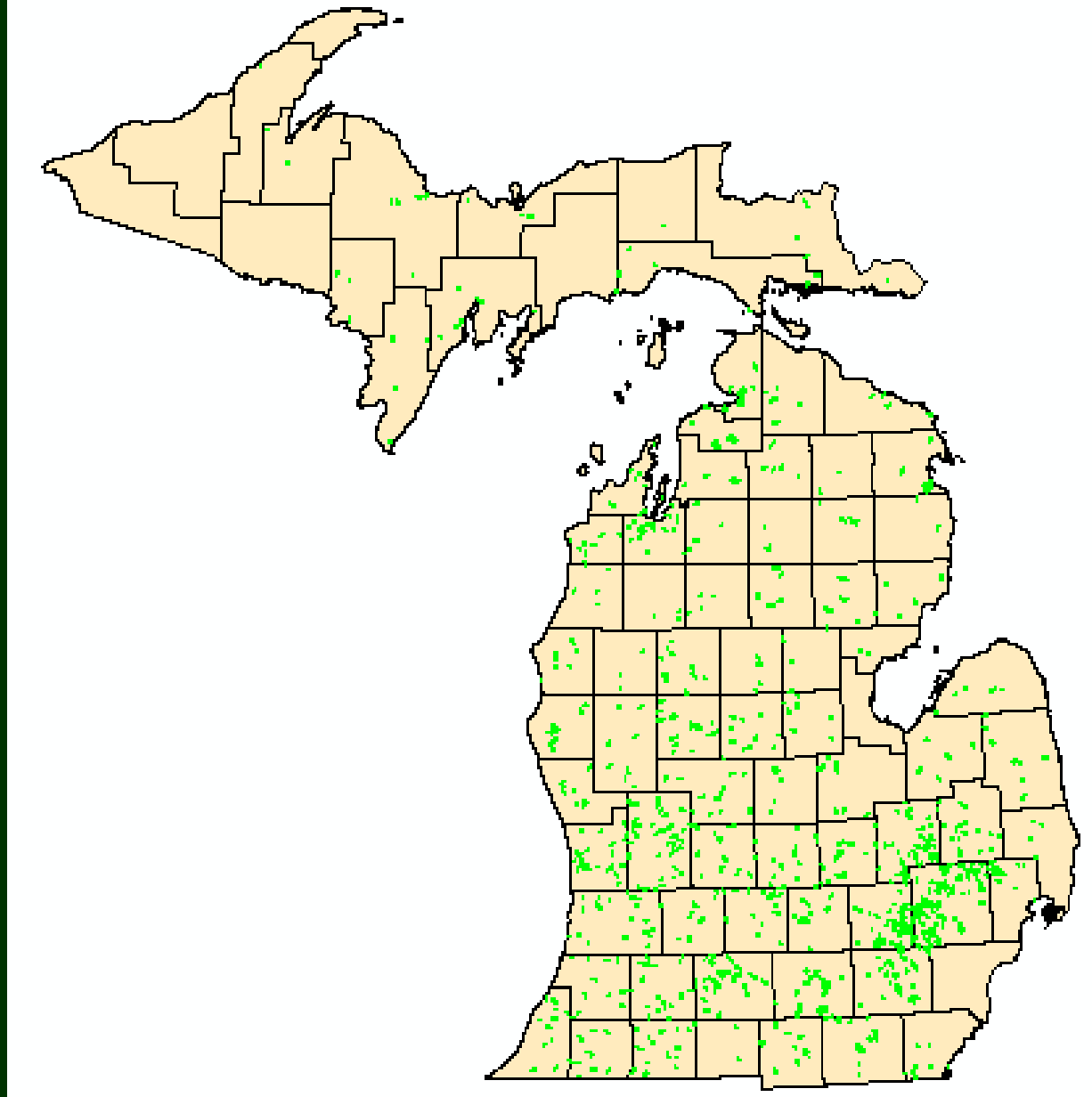
Available Data



Nontransient Noncommunity Water Supplies

- **1,841 Wells**
  Location Confirmed with Wellogic
- **Provisional WHPAs**
  1394

Available Data



Post—MGMT

WHPA STATISTICS

Type I NTR WHPAs

1270 WHPAs – 1601.22 mi²

Low Vulnerability

Type II NTR WHPAs

53 SWPAs - 158.14 mi²

1394 WWPAs – 814.46 mi²

Traditional

329 WHPAs – 646.69 mi²

Total

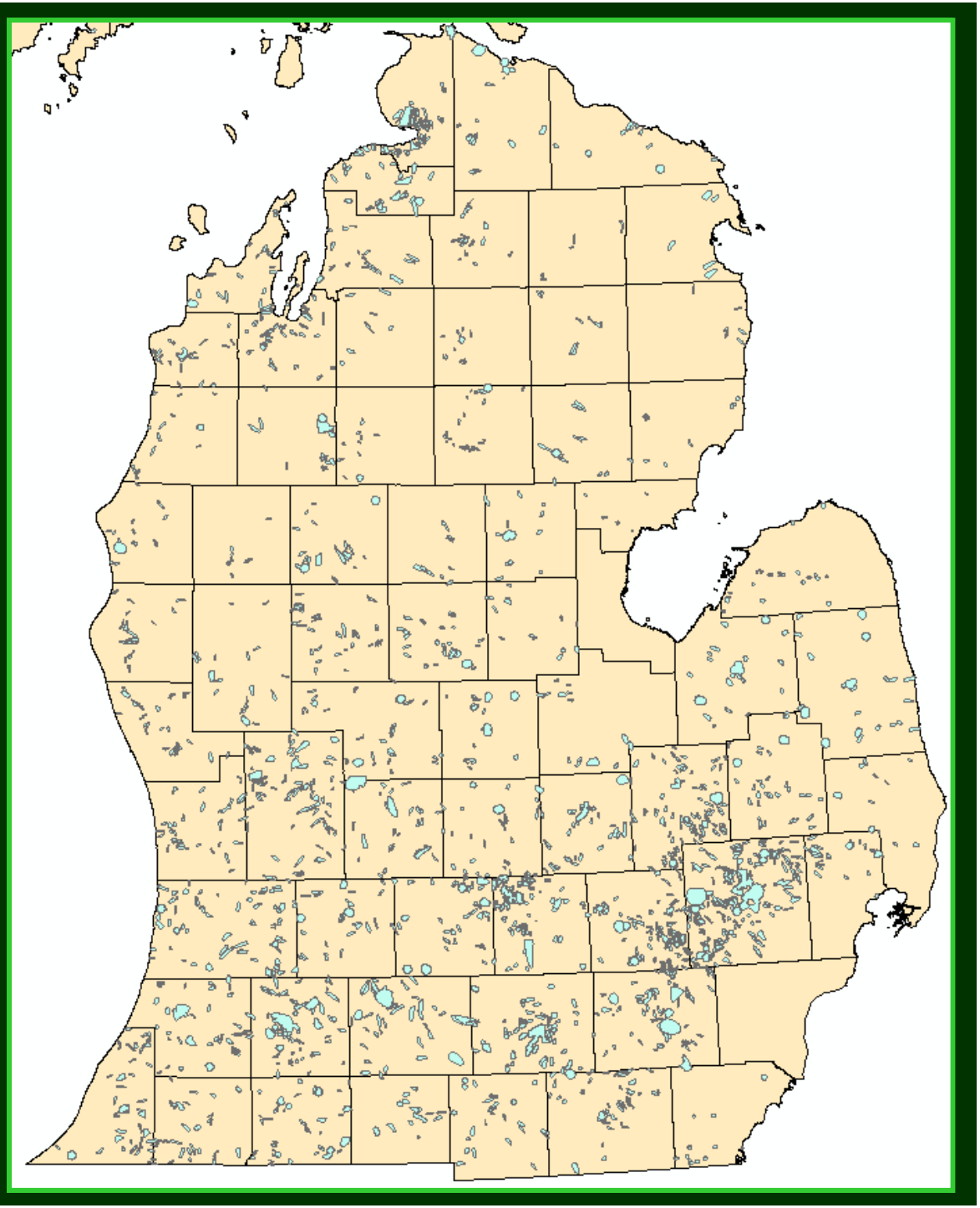
2664 WHPAs – 2415.68 mi²

382 SWPAs or WHPAs

WHPAs as Percentage

2.498 %

Pre-MGMT: 0.832%



Pre – MGMT
WHPA STATISTICS

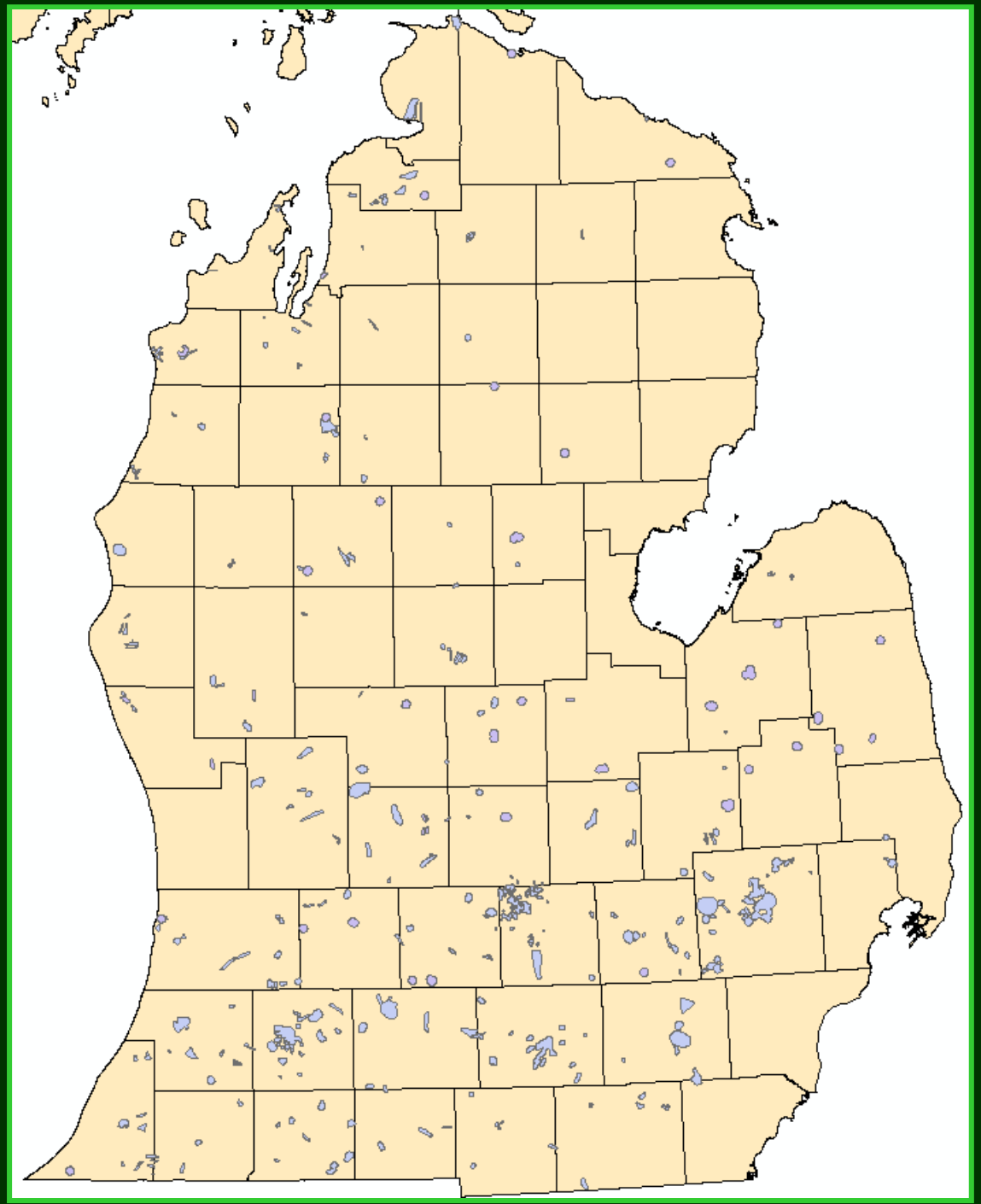
Area of Michigan
96,716 mi²

Low Vulnerability
53 SWPAs - 158.14 mi²

Traditional
329 WHPAs - 646.69 mi²

<u>Total</u>
382 SWPAs or WHPAs
804.83 mi²

Pre-MGMT: 0.832%



Post – MGMT
WHPA STATISTICS

Type I WHPAs

1270 WHPAs – 1601.22 mi^2

Type II NTR WHPAs

1394 WWPAs – 814.46 mi^2

Total

2664 WHPAs – 2415.68 mi^2

<u>WHPAs as Percentage</u>

2.498 %